

Tennessee Science Curriculum Framework

Biology for Technology

Biology for Technology is a rigorous laboratory science course that utilizes applied methodologies to prepare for taking the Gateway assessment. It has been designed jointly between the areas of science and career and technical education to prepare students for both postsecondary education and the workplace.

Life in modern society requires a broad knowledge of science. Basic scientific literacy is vital for all citizens, and science and technology are integral to almost all occupations. Studies show that US students do not have the grounding needed in science to pursue many science-related careers important to the growth of our nation.

This course is designed to build understanding of the principles of biology inherent to technology; apply the scientific method and processes in simulating work conditions through participation in research, problem solving, and teamwork; and develop higher-order thinking skills and communication skills. Specific content includes how living organisms come into existence, grow and mature, differentiate from one another, and interact with the environment.

Inquiry

Embedded Conceptual Strand - Inquiry

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question - Inquiry

What tools, skills, and knowledge are needed to conduct scientific inquiry?

Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Course Level Expectations

CLE 3258.Inq.1 Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

- CLE 3258.Inq.2** Design and conduct scientific investigations to explore new phenomena, verify previous results, test how well a theory predicts, and compare opposing theories.
- CLE 3258.Inq.3** Use appropriate tools and technology to collect precise and accurate data.
- CLE 3258.Inq.4** Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias.
- CLE 3258.Inq.5** Compare experimental evidence and conclusions with those drawn by others about the same testable question.
- CLE 3258.Inq.6** Communicate and defend scientific findings.

Checks for Understanding (Formative/Summative Assessment)

- ✓**3258.Inq.1** Trace the historical development of a scientific principle or theory, such as cell theory, evolution, or DNA structure.
- ✓**3258.Inq.2** Conduct scientific investigations that include testable questions, verifiable hypotheses, and appropriate variables to explore new phenomena or verify the experimental results of others.
- ✓**3258.Inq.3** Select appropriate tools and technology to collect precise and accurate quantitative and qualitative data.
- ✓**3258.Inq.4** Determine if data supports or contradicts a hypothesis or conclusion.
- ✓**3258.Inq.5** Compare or combine experimental evidence from two or more investigations
- ✓**3258.Inq.6** Recognize, analyze, and evaluate alternative explanations for the same set of observations.
- ✓**3258.Inq.7** Analyze experimental results and identify possible sources of experimental error.
- ✓**3258.Inq.8** Formulate and revise scientific explanations and models using logic and evidence.
- ✓**3258.Inq.9** Relate inquiry methods to problems encountered in a variety of careers.

State Performance Indicators

- SPI 3258 Inq.1** Select a description or scenario that reevaluates and/or extends a scientific finding.
- SPI 3258 Inq.2** Analyze the components of a properly designed scientific investigation.
- SPI 3258 Inq.3** Determine appropriate tools to gather precise and accurate data.
- SPI 3258 Inq.4** Evaluate the accuracy and precision of data.
- SPI 3258 Inq.5** Defend a conclusion based on scientific evidence.
- SPI 3258 Inq.6** Determine why a conclusion is free of bias.
- SPI 3258 Inq.7** Compare conclusions that offer different, but acceptable explanations for the same set of experimental data.

Embedded Technology and Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

How do science concepts, engineering skills, and applications of technology improve the quality of life?

Course Level Expectations

CLE 3258.T/E.1 Explore the impact of technology on social, political, and economic systems.

CLE 3258.T/E.2 Differentiate among elements of the engineering design cycle: design constraints, model building, testing, evaluating, modifying, and retesting.

CLE 3258.T/E.3 Explain the relationship between the properties of a material and the use of the material in the application of a technology.

CLE 3258.T/E.4 Describe the dynamic interplay among science, technology, and engineering within living, earth-space, and physical systems.

Checks for Understanding (Formative/Summative Assessment)

✓**3258. T/E.1** Select appropriate tools to conduct a scientific inquiry.

✓**3258. T/E.2** Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.

✓**3258. T/E.3** Explore how the unintended consequences of new technologies can impact human and non-human communities.

✓**3258. T/E.4** Present research on current bioengineering technologies that advance health and contribute to improvements in our daily lives.

✓**3258. T/E.5** Design a series of multi-view drawings that can be used by other students to construct an adaptive design and test its effectiveness.

State Performance Indicators

SPI 3258.T/E.1 Distinguish among tools and procedures best suited to conduct a specified scientific inquiry.

SPI 3258.T/E.2 Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.

SPI 3258.T/E.3 Evaluate the overall benefit to cost ratio of a new technology.

SPI 3258.T/E.4 Assess the principles that determine if a new technology will improve the quality of life for an intended audience.

Standard 1 – Cells

Conceptual Strand 1

All living things are made of cells that perform functions necessary for life.

Guiding Question 1

How are cells organized to carry on the processes of life?

Course Level Expectations

- CLE 3258.1.1** Compare the structure and function of cellular organelles in both prokaryotic and eukaryotic cells.
- CLE 3258.1.2** Distinguish among the structure and function of the four major organic macromolecules found in living things.
- CLE 3258.1.3** Describe how enzymes regulate chemical reactions in the body.
- CLE 3258.1.4** Describe the processes of cell growth and reproduction.
- CLE 3258.1.5** Compare different models used to explain the movement of materials into and out of cells.

Check for Understanding (Formative/Summative Assessment)

- ✓**3258.1.1** Investigate cells using a compound microscope.
- ✓**3258.1.2** Construct a model of a prokaryotic or eukaryotic cell.
- ✓**3258.1.3** Design and conduct an experiment to investigate the effect of various solute concentrations on water movement in cells.
- ✓**3258.1.4** Design a graphic organizer that compares the structure and function of proteins, carbohydrates, lipids, and nucleic acids.
- ✓**3258.1.5** Conduct tests to detect the presence of proteins, carbohydrates, and lipids.
- ✓**3258.1.6** Analyze experimental data to distinguish between active and passive transport.
- ✓**3258.1.7** Model the movement of chromosomes during mitosis in plant and animal cells.
- ✓**3258.1.8** Use food labels to investigate the dietary value of various food items in relation to lipids, carbohydrates, and proteins.

State Performance Indicators

- SPI 3258.1.1** Identify the cellular organelles associated with major cell processes.
- SPI 3258.1.2** Distinguish between prokaryotic and eukaryotic cells.
- SPI 3258.1.3** Distinguish among proteins, carbohydrates, lipids, and nucleic acids.
- SPI 3258.1.4** Identify a positive test for carbohydrates, lipids, and proteins.
- SPI 3258.1.5** Identify how enzymes control chemical reactions in the body.
- SPI 3258.1.6** Determine the relationship between cell growth and cell reproduction.
- SPI 3258.1.7** Predict the movement of water and other molecules across selectively permeable membranes.
- SPI 3258.1.8** Compare and contrast active and passive transport.

Standard 2 – Interdependence

Conceptual Strand 2

All life is interdependent and interacts with the environment.

Guiding Question 2

How do living things interact with one another and with the non-living elements of their environment?

Course Level Expectations

CLE 3258.2.1 Investigate how the dynamic equilibrium of an ecological community is associated with interactions among its organisms.

CLE 3258.2.2 Analyze and interpret population data, graphs, or diagrams.

CLE 3258.2.3 Predict how climate change, human activity, geologic events, and the introduction of non-native species impact an ecosystem.

CLE 3258.2.4 Describe the events associated with biological succession.

Check for Understanding (Formative/Summative Assessment)

✓**3258.2.1** Analyze human population graphs to predict the impact on global resources, and economic and social factors.

✓**3258.2.2** Construct and maintain a model of an ecosystem. Include a food web to show relatedness, interdependency, and relation to extinction.

✓**3258.2.3** Monitor and evaluate changes in a yeast population.

✓**3258.2.4** Use an outdoor habitat to identify the abiotic and biotic factors, plant and animal populations, producers, consumers, and decomposers.

✓**3258.2.5** Conduct research on how human influences have changed an ecosystem; communicate findings through written or oral presentations.

✓**3258.2.6** Describe a sequence of events that illustrates biological succession.

✓**3258.2.7** Select a local environmental issue and role-play officials, workers, citizens, and special interest groups.

✓**3258.2.8** Interview an environmental agent to determine local issues of interdependence.

State Performance Indicators

SPI 3258.2.1 Predict how population changes of organisms at different trophic levels affect an ecosystem.

SPI 3258.2.2 Interpret the relationship between environmental factors and fluctuations in population size.

SPI 3258.2.3 Determine how the carrying capacity of an ecosystem is affected by interactions among organisms.

SPI 3258.2.4 Predict how various types of human activities affect the environment.

SPI 3258.2.5 Make inferences about how a specific environmental change affects biodiversity.

SPI 3258.2.6 Predict how an environmental change may lead to the extinction of a species.

SPI 3258.2.7 Analyze factors responsible for biological succession.

Standard 3 – Matter and Energy

Conceptual Strand 3

Matter cycles and energy flows through the biosphere.

Guiding Question 3

What are the scientific explanations for how matter cycles and energy flows through the biosphere?

Course Level Expectations

CLE 3258.3.1 Analyze energy flow through an ecosystem..

CLE 3258.3.2 Investigate the relationship between the processes of photosynthesis and aerobic cellular respiration.

CLE 3258.3.3 Investigate various types of respiration.

CLE 3258.3.4 Describe the events which occur during the major biogeochemical cycles.

Check for Understanding (Formative/Summative Assessment)

✓**3258.3.1** Track energy flow through an ecosystem.

✓**3258.3.2** Conduct an experiment to investigate photosynthesis and cellular respiration.

✓**3258.3.3** Construct concept maps to explain the processes of photosynthesis and cellular respiration.

✓**3258.3.4** Investigate the importance of industrial applications of fermentation.

✓**3258.3.5** Construct models of the carbon, oxygen, nitrogen, phosphorous, and water cycles.

✓**3258.3.6** Keep a food diary for one week and analyze energy consumption and use.

✓**3258.3.7** Develop a week-long cafeteria menu based on recommended dietary intake.

State Performance Indicators

SPI 3258.3.1 Interpret a diagram that illustrates energy transformations in an ecosystem.

SPI 3258.3.2 Compare and contrast photosynthesis and cellular respiration in terms of energy transformation.

SPI 3258.3.3 Distinguish between aerobic and anaerobic respiration.

SPI 3258.3.4 Predict how changes in a biogeochemical cycle can affect an ecosystem.

Standard 4 – Heredity

Conceptual Strand 4

Organisms reproduce and transmit hereditary information.

Guiding Question 4

What are the principal mechanisms by which living things reproduce and transmit hereditary information from parents to offspring?

Course Level Expectations

CLE 3258.4.1 Investigate how genetic information is encoded in nucleic acids.

CLE 3258.4.2 Describe the relationships among genes, chromosomes, proteins, and hereditary traits.

CLE 3258.4.3 Compare different patterns of inheritance (i.e., simple dominance, sex linkage, co-dominance, incomplete dominance, multiple alleles, and polygenic traits).

CLE 3258.4.4 Recognize how meiosis and sexual reproduction contribute to genetic variation in a population.

CLE 3258.4.5. Describe the role of mutations in human genetic disorders.

CLE 3258.4.6 Assess the scientific and ethical ramifications of emerging genetic technologies (e.g., recombinant DNA, cloning, transgenic organisms, stem cells, and DNA fingerprinting.)

Check for Understanding (Formative/Summative Assessment)

✓**3258.4.1** Use models of DNA, RNA, and amino acids to explain replication and protein synthesis.

✓**3258.4.2** Complete and interpret genetics problems that illustrate simple dominance, sex linkage, co-dominance, incomplete dominance, multiple alleles, and polygenic traits.

✓**3258.4.3** Apply data to complete and interpret a genetic pedigree.

✓**3258.4.4** Describe how the process of meiosis affects the number of chromosomes in a gamete.

✓**3258.4.5** Associate gene mutation with changes in the DNA molecule.

✓**3258.4.6** Design an informational brochure to describe a human genetic disorder.

✓**3258.4.7** Conduct research to explore the scientific and ethical issues surrounding emerging DNA technologies.

✓**3258.4.8** Research careers that relate to genetics and inheritance, such as lab technician, forensic pathologist, livestock breeder, genetic counselor, medical doctor, and role-play discussion of a genetic issue by that professional.

State Performance Indicators

SPI 3258.4.1 Identify the structure and function of DNA.

SPI 3258.4.2 Associate the process of DNA replication with its biological significance.

SPI 3258.4.3 Recognize the interactions between DNA and RNA during protein synthesis.

SPI 3258.4.4. Determine the probability of a particular trait in an offspring, given the genotype of the parents and the mode of inheritance.

SPI 3258.4.5 Apply pedigree data to interpret various modes of genetic inheritance.

SPI 3258.4.6 Describe how meiosis is involved in the production of egg and sperm cells.

SPI 3258.4.7 Describe how meiosis and sexual reproduction contribute to the amount of genetic variation in a population

SPI 3258.4.8 Determine the relationship between mutations and human genetic disorders.

SPI 3258.4.9 Evaluate the scientific and ethical issues associated with genetic technologies.

Standard 5 – Biodiversity and Change

Conceptual Strand 5

A rich variety and complexity of organisms have developed in response to changes in the environment.

Guiding Question 5

How does natural selection explain how organisms have changed over time?

Course Level Expectations

- CLE 3258.5.1** Associate structural, functional, and behavioral adaptations with the ability of organisms to survive under various environmental conditions.
- CLE 3258.5.2** Analyze the relationship between form and function in living things.
- CLE 3258.5.3** Explain how genetic variation and changing environmental conditions can result in adaptation of populations and the emergence of new species.
- CLE 3258.5.4** Summarize the supporting evidence for the theory of evolution.
- CLE 3258.5.5** Explain how evolution contributes to the amount of biodiversity.
- CLE 3258.5.6** Explore the evolutionary basis of modern classification systems.

Check for Understanding (Formative/Summative Assessment)

- ✓**3258.5.1** Create graphic organizers to demonstrate the relationship between form and function in representative organisms.
- ✓**3258.5.2** Predict the types of plants and animals indigenous to a biome by determining the characteristics of that biome.
- ✓**3258.5.3** Demonstrate how natural selection in response to a changing environment may exhibit new characteristics and may form a new species.
- ✓**3258.5.4** Investigate causes and consequences of antibiotic resistance.
- ✓**3258.5.5** Associate fossil data with biological and geological changes in the environment.
- ✓**3258.5.6** Analyze a variety of models, samples, or diagrams to demonstrate the genetic relatedness of organisms.
- ✓**3258.5.7** Use a dichotomous key to identify an unknown organism.
- ✓**3258.5.8** Investigate an organism that has or may become extinct and examine the impact of humans on the species.
- ✓**3258.5.9** Design a scale model of a time line showing emergence and extinction of various life forms on earth.

State Performance Indicators

- SPI 3258.5.1** Compare and contrast the structural, functional, and behavioral adaptations of animals or plants found in different environments.
- SPI 3258.5.2** Recognize the relationship between form and function in living things.
- SPI 3258.5.3** Recognize the relationships among environmental change, natural selection, and the emergence of a new species.
- SPI 3258.5.4** Determine how the amount of biodiversity and the ability of a population to adapt to a changing environment are related.
- SPI 3258.5.5** Apply evidence from the fossil record, comparative anatomy, DNA, and protein sequences to support modern classification systems.

SPI 3258.5.6 Infer relatedness among different organisms using modern classification systems.